Peabody Museum
of Natural History
Yale University
New Haven, CT 06511

Postilla Number 185
31 December 1981

A New Species of *Conoryctella* (Mammalia: Taeniodonta) from the Paleocene of the San Juan Basin, New Mexico, and a Revision of the Genus

Robert M. Schoch
Spencer G. Lucas

(Received 26 January 1981)

Abstract

Specimens from Paleocene strata of the Nacimiento Formation in Kutz Canyon, San Juan Basin, New Mexico, add to our knowledge of the poorly known taeniodont genus *Conoryctella* Gazin, 1939 and provide evidence for its taxonomic revision. *C. dragonensis* Gazin, 1939 is only known with certainty from its type specimen from the Dragon local fauna, North Horn Formation in east-central Utah, although a poorly preserved maxillary fragment and canine of uncertain provenance from the San Juan Basin, New Mexico, may pertain to this taxon. *C. pattersoni*, new species, differs from *C. dragonensis* in its smaller size, less molariform P^4 and relatively narrow upper molars. It is known from: dental remains from the Dragon local fauna previously referred to *C. dragonensis* by Gazin (1939, 1941); dental remains from Torrejonian strata in Kutz Canyon referred by Wilson (1956, p. 82) to "conoryctine, n. gen. and sp."; and newly discovered dental and postcranial remains from a horizon in Kutz Canyon that, based on magnetostratigraphy (Tomida and Butler, 1980), is temporally equivalent to the Dragon local fauna. The occurrences of *Conoryctella* in the San Juan Basin extend the geographic range of the genus and also extend its time-stratigraphic range into a typical Torrejonian horizon. These extensions further reduce the distinctiveness of the Dragon local fauna, supporting recent arguments that the Dragon local fauna should be considered early Torrejonian in age.

Key Words

Conoryctella, Taeniodonta, Dragonian, Torrejonian, fossil mammal, San Juan Basin.

Introduction

In 1977 one of us (SGL) collected a taeniodont palate, right dentary and parts of two ulnae from Paleocene strata of the Nacimiento Formation in Kutz Canyon, San Juan Basin, New Mexico. This specimen and three fragmentary University of Kansas specimens from Kutz Canyon reported by Wilson (1956) as "conoryctine, n. gen. and sp." represent a new species of *Conoryctella* Gazin, 1939, described here. Not only do these new specimens help to better define the poorly known genus *Conoryctella*, but they also are the first occurrence of the genus outside of its type locality in the Dragon local fauna of the North Horn Formation in east-central Utah. This occurrence thus aids in the correlation of the Dragon local fauna with the Paleocene faunas of the San Juan Basin, New Mexico, a problem that has plagued vertebrate biostratigraphy for nearly 40 years.

Abbreviations

The following institutions are referred to in the text:

AMNH	American Museum of Natural History, New York City
UALP	University of Arizona Laboratory of Paleontology, Tucson
UK	University of Kansas, Lawrence
UNM	University of New Mexico, Albuquerque
USNM	United States National Museum, Washington, D.C.

Tooth nomenclature follows Szalay (1969, Table 1, fig. 1).

Order Taeniodonta Cope, 1876
Family Stylinodontidae Marsh, 1875
Subfamily Conoryctinae Schlosser, 1911
Conoryctella Gazin, 1939

Type Species

Conoryctella dragonensis Gazin, 1939

Included Species

The type species and *Conoryctella pattersoni*, n. sp.

Known Distribution

Torrejonian (middle Paleocene) of Utah and New Mexico.

Revised Diagnosis

Medium-sized conoryctines, larger than *Onychodectes* but smaller than *Conoryctes*; teeth more hypsodont than *Onychodectes* but less hypsodont than *Conoryctes*; P^4 nonmolariform with well-developed protocone and paracone, but only an incipient metacone; stylocone and parastyle absent on P^4 or only slightly developed (in contrast to *Onychodectes* and *Conoryctes* in which they usually are moderately well developed); symphysis of lower jaw unfused; lower canine relatively large, heavily invested with enamel, triangular in cross section, transversely compressed and tending towards the rootless condition seen in stylinodontine taeniodonts; P_4 submolariform with a single protoconid anteriorly and a moderately developed talonid posteriorly; lower molar paraconids relatively large.

Conoryctella dragonenis Gazin, 1939

(Fig. 2a, b)

Holotype

USNM 15704, left maxilla bearing damaged P^4–M^2 and part of the P^3 alveolus.

Horizon and Locality of the Type

Dragon local fauna, Torrejonian (middle Paleocene), upper part of the North Horn Formation, NW¼, Sec. 8, T19S, R6E, Emery Co., Utah (Fig. 1; Gazin 1939, 1941).

Referred Specimens

Only known from the holotype.

Revised Diagnosis

Largest known species of *Conoryctella*; differs from *C. pattersoni* in the following features: P^4 with slightly better developed metacone and incipient stylocone; M^{1-2} relatively wide with reduced stylar shelves, slight ectoflexi and small mesostyles.

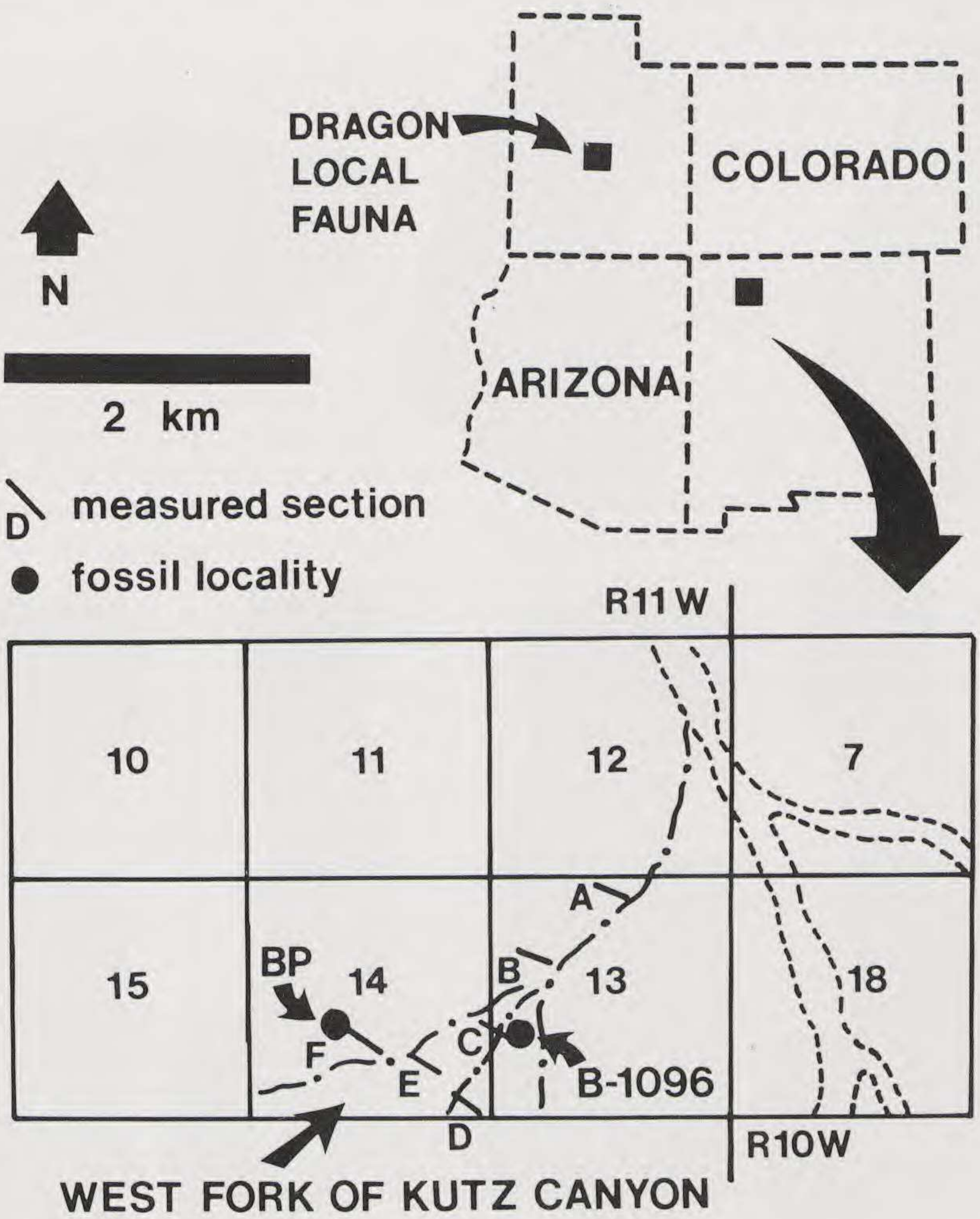
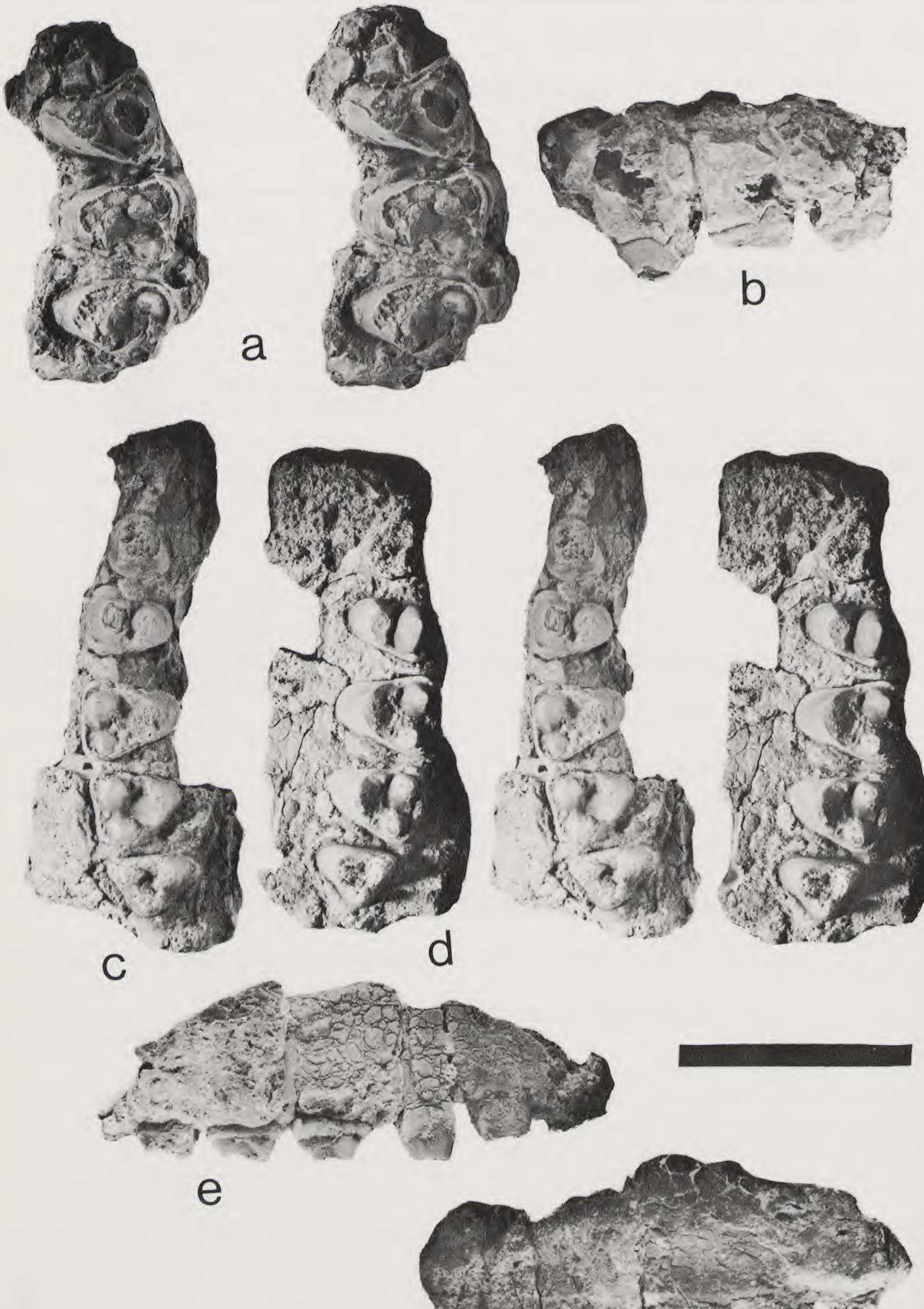


Fig. 1
Map of the west fork of Kutz Canyon, San Juan Basin, New Mexico, Secs. 10–15, T27N, R11W and Secs. 7 and 18, T27N, R10W (after USGS Bloomfield, New Mexico, 15′ quadrangle map). The location of the measured sections (A–F) in Figure 8, UNM locality B-1096 (the type locality of *Conoryctella pattersoni* Schoch and Lucas, n. sp.) and the Big Pocket locality (*BP*) are shown.


a
b
c
d
e
f

Description

The type and only surely known specimen of *C. dragonensis*, USNM 15704 (described and illustrated by Gazin, 1939, pp. 276–277, fig. 1, 1; 1941, pp. 15–17, fig. 8) is a left maxilla fragment bearing damaged P^4–M^2 and part of the P^3 alveolus (Fig. 2a, b). From the partial alveolus it appears that the P^3 was three-rooted. P^4, M^1 and M^2 are three-rooted and approach the degree of hypsodonty seen in *Conoryctes* (Matthew, 1937, pl. 58, fig. 2). P^4 lacks an external cingulum and bears a strong protocone and paracone, a small metacone connected to the protocone by a weak postprotocristid, and an incipient "stylocone" (or parastyle: the homology of this cuspule is uncertain). M^1 and M^2 both bear strong protocones and smaller, labially-placed and low conical paracones and metacones, and have narrow stylar shelves. Both molars also have moderately-developed, cuspidate ectocingula, small mesostyles and shallow ectoflexi.

Discussion

The specimens, USNM 15722 (Fig. 5a, b, c) and USNM 16173 (Fig. 5g, h, i, j, k, l), referred to *C. dragonensis* by Gazin (1939, 1941) are here referred to *C. pattersoni*, n. sp. As Gazin noted (1939, 1941), these specimens are from a smaller animal than USNM 15704. They are virtually identical in size and morphology to the lower molars of the type of *C. pattersoni*, UNM B-1258 (Fig. 3). AMNH 3412 (Fig. 7) may possibly represent *C. dragonensis*, but because of its poor preservation it cannot definitely be identified (see later discussion).

◀ **Fig. 2**
The type specimen of *Conoryctella dragonensis* Gazin, 1939 (USNM 15704) and the upper dentition of the type specimen of *C. pattersoni* Schoch and Lucas, n. sp. (UNM B-1258): *a*, stereophotograph of occlusal view of USNM 15704, left maxilla bearing damaged P^4–M^2 and part of the P^3 alveolus; *b*, labial view of USNM 15704; *c*, stereophotograph of occlusal view of UNM B-1258, right maxilla bearing P^4–M^3 and roots of P^{2-3}; *d*, stereophotograph of occlusal view of UNM B-1258, left maxilla bearing P^4–M^3 and roots of P^{2-3}; *e*, labial view of UNM B-1258, right maxilla; *f*, labial view of UNM B-1258, left maxilla. Scale = 2 cm.

Conoryctella pattersoni Schoch and Lucas, new species

(Figs. 2c, d, e, f; 3; 4; 5; 6a, c)
conoryctine, n. gen. and sp.: Wilson, 1956, p. 82
n. gen. et sp.: Russell, 1967, p. 68.
Conoryctella: Schoch and Lucas, 1981, p. 225.
Conoryctes comma: Taylor, 1981, p. 250, 251, 259, 262; Text fig. 11.3; Pl. 11.1, fig. 4.
n. gen. and n. sp.: Taylor, 1981, p. 259.
n. gen. et sp.: Tsentas, 1981, p. 272.

Holotype

UNM B-1258: palate with right and left P^4–M^3 and roots of right and left P^{2-3}; right dentary with C_1, P_3–M_3 and roots of I_{1-3}; incomplete right and left ulnae. (The ulnae are presumed to be from the same individual as the dentition since they clearly belong to a conoryctine taeniodont and were found in close proximity to the dentition.)

Horizon and Locality of the Type

Kutz Canyon local fauna (see Taylor, 1981), Torrejonian, Nacimiento Formation, UNM locality B-1096 in the NW¼, SW¼, Sec. 13, T27N, R11W, San Juan Basin, New Mexico.

Referred Specimens

USNM 15722, right dentary fragment with M_1 and base and roots of P_4; USNM 16173, fragmentary and isolated M_1 and M_2; USNM 18538, right dentary fragment with M_3: all from the Dragon local fauna, Torrejonian (middle Paleocene), upper part of the North Horn Formation, NW¼, Sec. 8, T19S, R6E, Emery Co., Utah (Fig. 1; Gazin, 1939, 1941). UK 7807, right dentary fragment

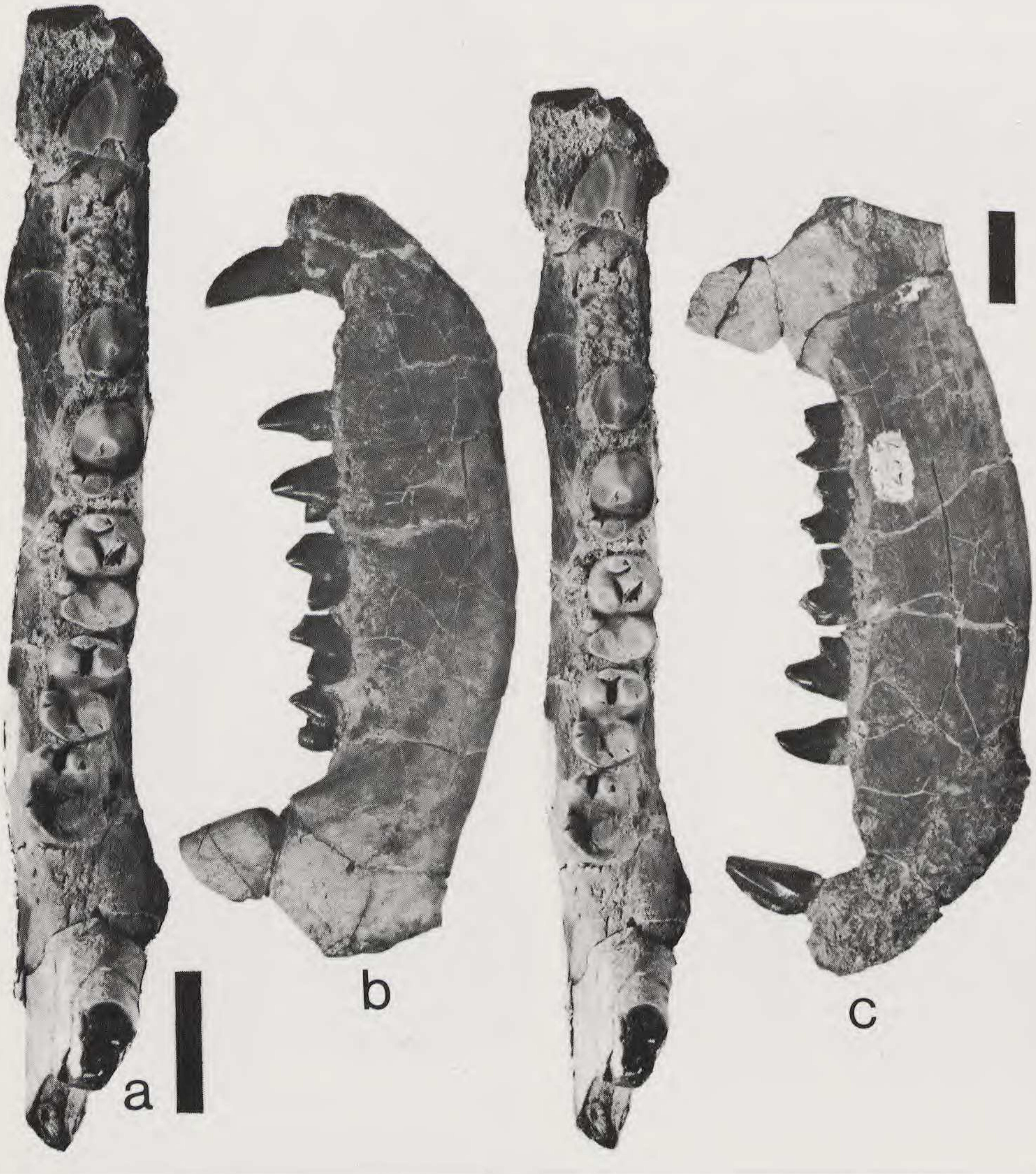
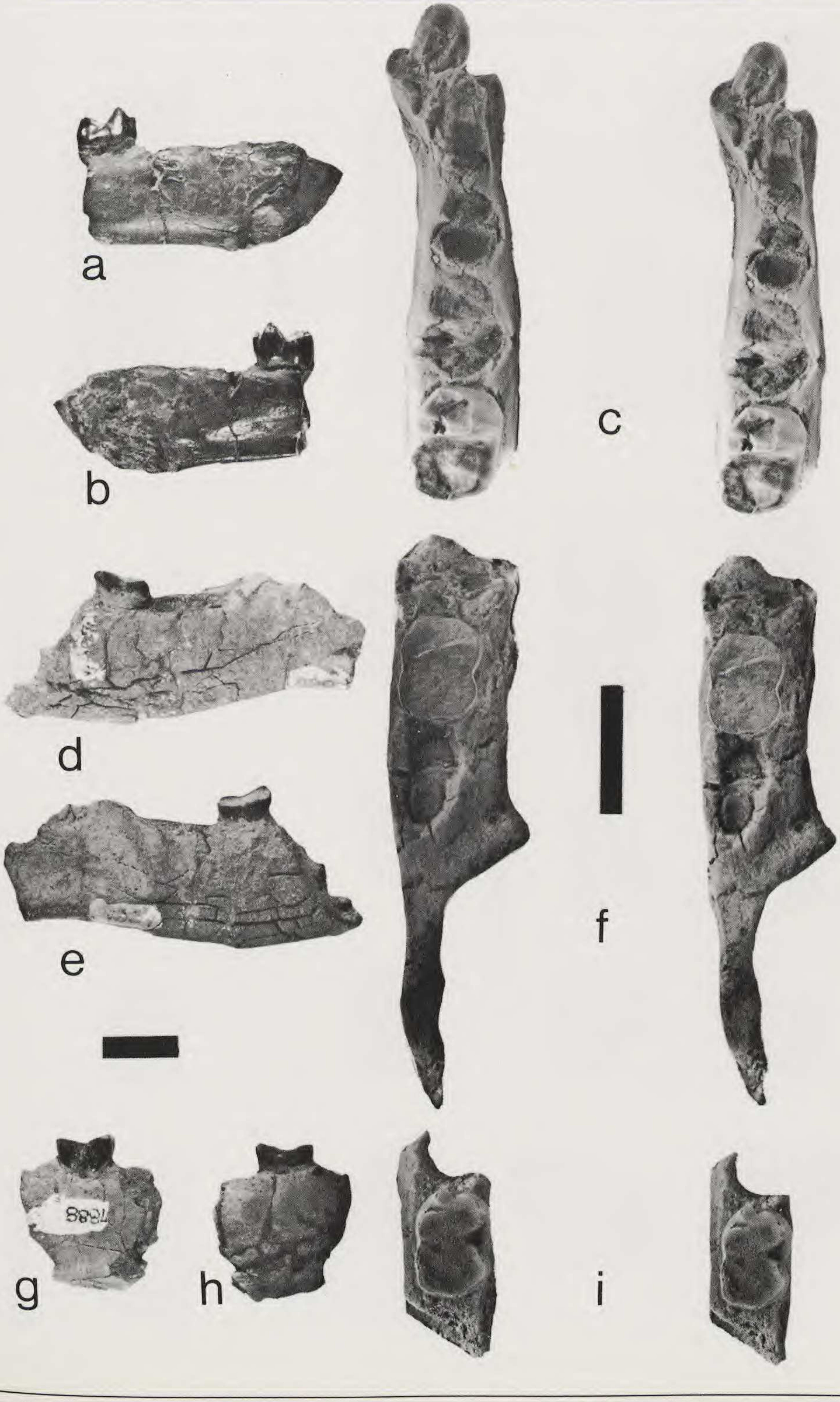
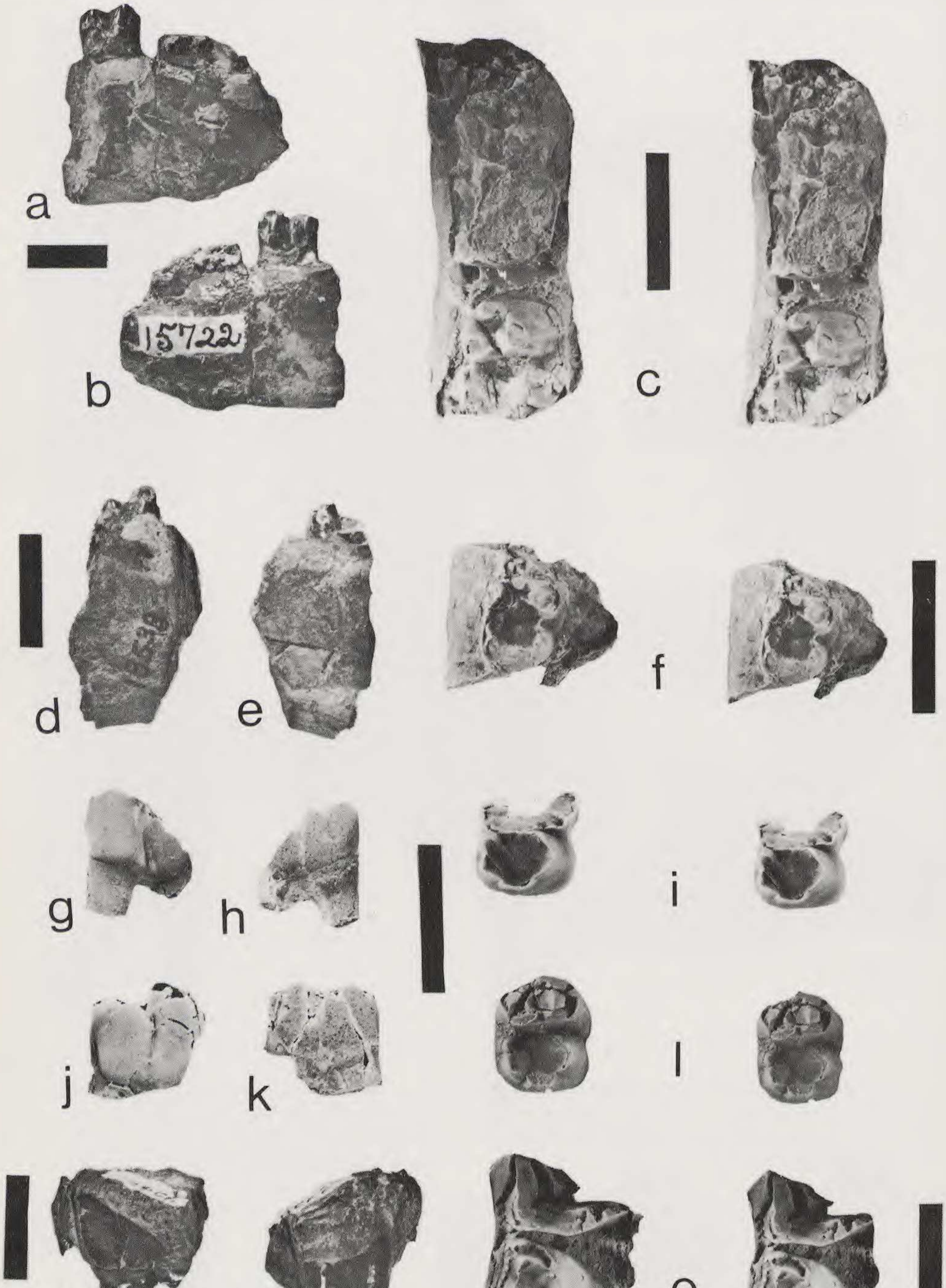


Fig. 3▲
The lower dentition of the type specimen of *Conoryctella pattersoni* Schoch and Lucas, n. sp. (UNM B-1258): *a*, stereophotograph of occlusal view of right dentary with C_1, P_3–M_3 and roots of I_{1-3}; *b*, labial view of the right dentary; *c*, lingual view of the right dentary. Scale for *a* = 1 cm. Scale for *b* and *c* = 1 cm.

Fig. 4 ▶
Referred specimens of *Conoryctella pattersoni* Schoch and Lucas, n. sp.: *a*, labial view of UK 9562, right dentary fragment with complete M_1, roots of C_1 and P_{1-4}; *b*, lingual view of UK 9562; *c*, stereophotograph of occlusal view of UK 9562; *d*, lingual view of UK 7807, right dentary fragment with M_2 and roots of M_3; *e*, labial view of UK 7807; *f*, stereophotograph of occlusal view of UK 7807; *g*, labial view of UK 7888, right dentary fragment with M_2 and partial M_1 alveolus; *h*, lingual view of UK 7888; *i*, stereophotograph of occlusal view of UK 7888. Scales = 1 cm. Note separate scales for *a,b,d,e,g,h*, and for *c,f*, and *i*.


a
b
c
d
e
f
g
h
i


a
b
15722
c
d
e
f
g
h
i
j
k
l
m
n
o

with M_2 and roots of M_3; UK 7888, right dentary fragment with M_2 and partial alveolus of M_1; UK 9562, left maxilla with partial M^1, M^2 and partial M^3 and right dentary fragment with complete M_1 and roots of C_1 and P_{1-4}: all from the Kutz Canyon local fauna, Torrejonian, Nacimiento Formation, "Big Pocket" locality in the NE¼, SW¼, Sec. 14, T27N, R11W[1] (Figs. 1, 8; Wilson, 1956). UALP 11661, left M^1 also from the Kutz Canyon local fauna, UALP locality 7662 (Taylor, 1981).

Etymology

Named for the late Bryan Patterson, in honor of his outstanding contributions to our knowledge of taeniodonts.

Diagnosis

Smallest known species of *Conoryctella*; differs from *C. dragonensis* in the following features: P^4 lacks a parastyle, stylocone and metacone; P^4 postprotocristid only slightly developed; upper molars relatively narrow.

[1] Wilson (1956, p. 77) and Wilson and Szalay (1972, pp. 5–6), among others, have incorrectly placed the Big Pocket locality in the NW¼, Sec. 14, T27N, R11W.

◀ **Fig. 5**
Referred specimens of *Conoryctella pattersoni* Schoch and Lucas, n. sp.: *a*, labial view of USNM 15722, right dentary fragment with M_1 and roots of P_4; *b*, lingual view of USNM 15722; *c*, stereophotograph of occlusal view of USNM 15722; *d*, labial view of USNM 18538, right dentary fragment with M_3; *e*, lingual view of USNM 18538; *f*, stereophotograph of occlusal view of USNM 18538; *g*, labial view of USNM 16173, incomplete right M_1; *h*, lingual view of USNM 16173 (M_1); *i*, stereophotograph of occlusal view of USNM 16173 (M_1); *j*, labial view of USNM 16173, damaged right M_2; *k*, lingual view of USNM 16173 (M_2); *l*, stereophotograph of occlusal view of USNM 16173 (M_2); *m*, labial view of UK 9562, left maxillary fragment with partial M^1, M^2 and partial M^3; *n*, lingual view of UK 9562; *o*, stereophotograph of occlusal view of UK 9562. Scales = 1 cm. Note separate scales for a–b, c, d–e, f, g–l, m–n, o).

Description

The roots of P^{2-3} of *C. pattersoni* are present on the type (UNM B-1258); these teeth appear to have been three-rooted. The right and left P^4–M^3 are known from the type specimen, and a left M^2 with adjoining fragments of M^1 and M^3 is known from UK 9562. In all of their features the right and left upper teeth of the type specimen appear to be identical. P^4 is nonmolariform with a large, ovoid protocone and paracone and only the slightest hint of a metacone; a postprotocrista connects this incipient metacone to the protocone. P^4 also lacks a parastyle, stylocone and any cingula; it is relatively wider than the P^4 of *Onychodectes* (Cope, 1888, Pl. 5, fig. 8). M^{1-3} regularly decrease in size posteriorly. M^1 and M^2 are morphologically identical, except for size (Table 1). Both bear large, well-worn, protocones and smaller, conical paracones and metacones, the paracones being larger and taller than the metacones. M^1 and M^2 have moderately developed and cuspidate ectocingula, but lack mesostyles; the parastyles are moderately well developed. Although the paracones and metacones are positioned far labially, there is still a distinct stylar shelf. This stylar shelf is narrower on UK 9562 than on the type specimen. M^3 is the smallest of the upper cheek teeth and also bears a large, well-worn protocone and a conical paracone and metacone, although these cusps are more nearly subequal in size than on M^1 and M^2. The M^3 paracone and metacone also are positioned far labially and there is no stylar shelf or ectocingulum. All three molars lack any hint of pre- or postcingula or ectoflexi.

The lower dentition of *C. pattersoni* is known from the virtually complete right dentary of the type specimen (UNM B-1258), which lacks only the incisors and P_{1-2}, and from the miscellaneous lower molars among the referred specimens (USNM 15722, 16173, 18538; UK 7807, 7888, 9562). Traces of the roots on the type specimen suggest that *Conoryctella* had

Table 1 Dental measurements (in mm) of specimens of Conoryctella. L=length, W=width.

Asterisks (*) indicate that measurements of damaged or worn teeth are approximate.

Measurement Taken	Specimen Number									
	USNM 15704[a]	AMNH 3412	UNM B-1258[b]	USNM 15722	USNM 16173	USNM 18538	UK 7807	UK 7888	UK 9562	UALP 11661
C^1 L		9.8*								
C^1 W		5.6*								
P^4 L	7.4	7.6*	5.8							
P^4 W	10.1	8.1*	7.9							
M^1 L	8.1	8.3*	7.2							7.4
M^1 W	11.1	9.8*	8.6							9.2
M^2 L	7.4		6.8						6.0	
M^2 W	8.9		8.0						7.7	
M^3 L			5.7							
M^3 W			6.4							
C_1 L			5.5*							
C_1 W			4.9							
P_3 L			5.2							
P_3 W			3.7							

three lower incisors on each side, the I_2 being about twice as large as the two other incisors. The lower canine of *Conoryctella* is relatively large, but transversely compressed, triangular in cross section and heavily invested with enamel. As seen on UK 9562, the root of the canine extends far down and under P_{1-2} and thus has significantly developed towards the unfused, rootless condition seen in the stylinodontines (Patterson, 1949). The presence of P_1 and P_2 are documented on UK 9562 by the remains of their roots, P_1 being single-rooted and P_2 being double-rooted. P_3 is a simple, tall, sharp, slightly recurved and clawlike tooth consisting of a single, transversely compressed, protoconid with only the slighest hint of a posterior talonid. P_4 is nonmolariform and bears a large protoconid anteriorly and a small talonid posteriorly consisting of a large hypoconulid, a smaller entoconid and a still smaller entoconulid. The lower molars are all essentially identical morphologically, except that tooth size and paraconid size decrease posteriorly and are associated with a relatively more anterior placement of the metaconid. On each of the three molars, the talonid and trigonid are of equal width and length (Table 1). The trigonids bear large protoconids, slightly smaller metaconids, and still smaller paraconids. The talonids bear large hypoconids and entoconids, smaller hypoconulids, even smaller entoconulids and still smaller

Table 1 Continued

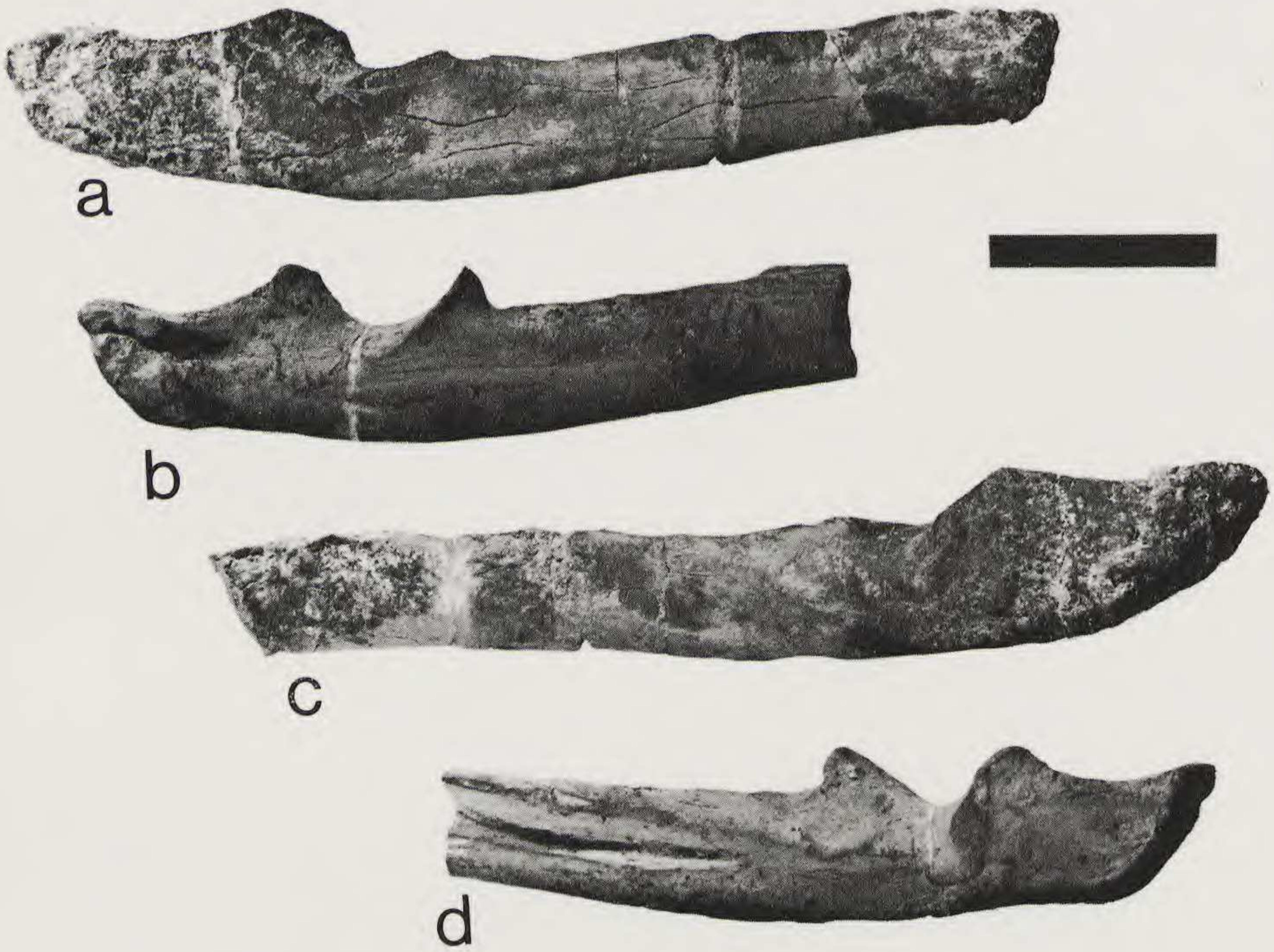
Measurement Taken	Specimen Number									
	USNM	AMNH	UNM	USNM	USMN	USNM	UK	UK	UK	UALP
	15704[a]	3412	B-1258[b]	15722	16173	18538	7807	7888	9562	11661
P_4L			6.9							
P_4W			4.9							
M_1L			8.7	8.0*					7.7	
M_1W			5.8	5.6*	6.4				5.3	
M_2L			8.0		7.8		7.2	7.4		
M_2W			5.3		5.7		5.3	5.2		
M_3L			6.9			6.2*				
M_3W			4.5			4.8				
Depth of ramus under M_1			20.1	18.2					12.0	

[a]Type specimen of Conoryctella dragonensis Gazin, 1939

[b]Type specimen of Conoryctella pattersoni Schoch and Lucas, n. sp.

cuspules (one on each molar) on the entocristids. All of the lower cheek teeth lack any cingulids. M_3 is placed well forward of the ascending ramus and the mandibular condyle appears to have been approximately at the level of the occlusal surface of the tooth row. In the type specimen of *C. pattersoni* the symphysis was unfused.

Two ulnae were collected with the dentition of the type specimen of *C. pattersoni*; of these, the left is more complete. This ulna of *Conoryctella* (Fig. 6a, c) is similar to the ulna of *Onychodectes* (AMNH 16410, Fig. 6b, d) described by Matthew (1937, p. 244). The body of the ulna of *Conoryctella* is approximately the same size or only slightly larger than the shaft of the ulna of *Onychodectes* and has a similar flattened shaft. However, although the lesser sigmoid cavity (radial notch) is flat in both *Onychodectes* and *Conoryctella*, in *Conoryctella* it is larger relative to the greater sigmoid cavity (semilunar notch) than in *Onychodectes*. In addition, the olecranon process on the ulna of *Conoryctella* is much larger and more robust than in *Onychodectes*, perhaps indicating a short and powerful forelimb in *Conoryctella* similar to the forelimb of the stylinodontine taeniodonts (Patterson, 1949).



?*Conoryctella* cf. *C. dragonensis*

(Fig. 7)

Referred Specimen

AMNH 3412, a poorly preserved left maxilla with P^4–M^3 largely encrusted with ironstone concretion and a left upper canine collected by David Baldwin for E. D. Cope in the 1880s from Paleocene strata of uncertain age, Nacimiento Formation, San Juan Basin, New Mexico.

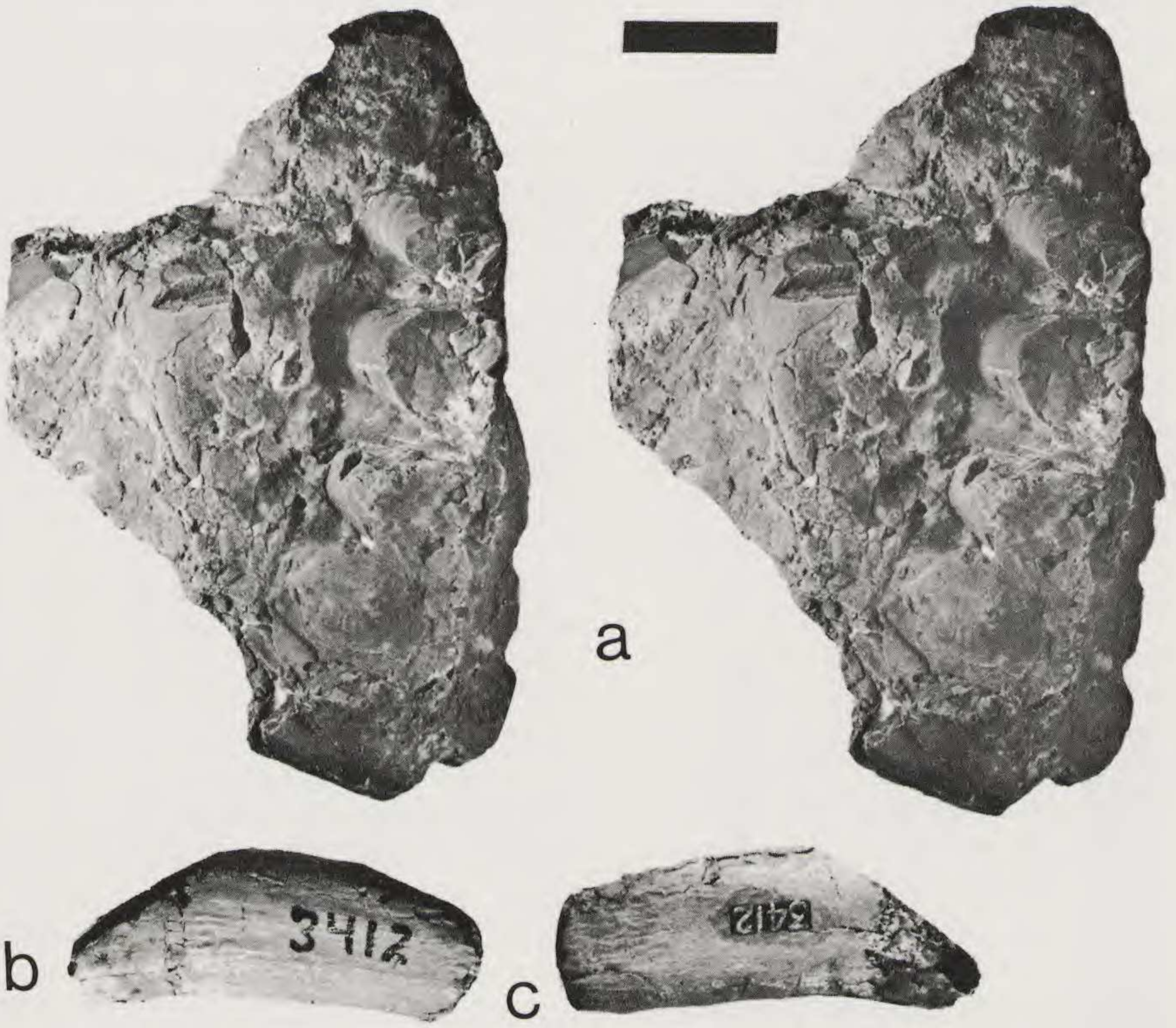
Discussion

This specimen may represent *Conoryctella*, but the teeth are so heavily encrusted with an impregnable ironstone concretion that their morphology is largely obscured and definitive taxonomic assignment

Fig. 6 ▲
Left ulnae of *Conoryctella pattersoni* Schoch and Lucas, n. sp. (UNM B-1258) and *Onychodectes tisonensis* Cope (AMNH 16410): *a*, external view of UNM B-1258; *b*, external view of AMNH 16410; *c*, internal view of UNM B-1258; *d*, internal view of AMNH 16410. Scale = 2 cm.

Fig. 7 ▶
Specimen here referred to ?*Conoryctella* cf. *C. dragonensis*, AMNH 3412: *a*, stereograph of occlusal view of left maxilla with damaged and encrusted P^4–M^3; *b*, labial view of left upper canine; *c*, lingual view of left upper canine. Scale = 1 cm.

thus is rendered difficult. The nonmolariform P^4 precludes assignment to *Conoryctes* in which the P^4 is always molariform (cf. Matthew, 1937, Pl. 58, fig. 2). Only approximate measurements can be taken on P^4 and M^1 (Table 1) and these are closest to the measurements of the



type specimen of *C. dragonensis.* Therefore, we tentatively refer AMNH 3412 to *C. dragonensis.* It thus may extend the range of that species into the San Juan Basin, but the lack of precise stratigraphic data for the specimen (we do not certainly know if it is of Torrejonian age, although we suspect that it is) coupled with its poor preservation render its interpretation speculative.

Conoryctella and the Status of the "Dragonian" Land Mammal "Age"

Whether or not the Dragon local fauna from east-central Utah is intermediate in age between the Puercan (early Paleocene) and Torrejonian (middle Paleocene) faunas of the San Juan Basin has been a problem since Gazin (1938, 1939, 1941) first described the Dragon mammals. This problem largely arose because Gazin named many new taxa, endemics of the Dragon local fauna, several of which he believed were evolutionary intermediates between Puercan and Torrejonian congeners or closely related genera. Wood et al. (1941) formalized this "intermediateness" by recognizing a "Dragonian" provincial "age" (= land mammal "age") betweeen the Puercan and Torrejonian.

Tomida and Butler (1980) and Tomida (1981) have recently presented new faunal and magnetostratigraphic evidence bearing on this question. They have demonstrated that the strata of the North Horn Formation in Utah containing the Dragon local fauna are slightly older than the strata of the Nacimiento Formation in New Mexico containing the Torrejonian mammals originally used to characterize the Torrejonian land mammal "age" (Wood et al., 1941; cf. Tomida and Butler, 1980; Fig. 8). In addition, Tomida (1981) recently discovered and described the typical Torrejonian mammals cf. *Paromomys* sp., *Protictis* cf. *P. haydenianus, Triisodon* cf. *T. antiquus,* cf. *Mioclaenus turgidus, Periptychus carinidens* and *Anisonchus sectorius* from strata of the Nacimiento Formation that are magnetostratigraphically correlated with the strata of the North Horn Formation containing the Dragon local fauna.

The occurrence of these typically Torrejonian taxa in an interval magnetostratigraphically correlated with the Dragon local fauna strengthens the argument that the Dragon local fauna is best considerd a Torrejonian fauna. It also supports Evernden et al. (1964, p. 152) who argued that much of the endemism of the Dragon local fauna "may represent nothing more than an environment yet unknown from the evidence presented by other Paleocene land-mammal samples." Tomida (1981, p. 237) concluded (as Sloan, 1970, fig. 6, evidently had) that "the 'Dragonian' time interval is more closely related to the Torrejonian both temporally and faunally than previously known" and thus advocated that "the 'Dragonian' Land Mammal 'Age' is best treated as earliest Torrejonian, and its status as a distinct land mammal 'age' should be abandoned."

The occurrence of *Conoryctella* in the San Juan Basin reported here supports this conclusion. *Conoryctella* occurs at two levels in Kutz Canyon (Fig. 8): 1. The type specimen of *C. pattersoni* occurs in a horizon magnetostratigraphically correlated by Tomida and Butler (1980) and Tomida (1981) with the horizon producing the Dragon local fauna. 2. The referred specimens of *C. pattersoni* occur at the Big Pocket locality at an acknowledged Torrejonian horizon (Taylor and Butler, 1980; Taylor, 1981). Thus the occurrence of *Conoryctella* in the San Juan Basin not only extends the geographic range of a taxon previously believed to be endemic to the Dragon local fauna, but also its stratigraphic range, which is extended upward into the Torrejonian. This further increases the faunal similarity of the Dragon local fauna with the Torrejonian fauna(s), reducing the faunal basis for recognizing a distinct "Dragonian" land mammal "age." It also raises the prospect that further collecting may extend the geographic and stratigraphic range of more Dragon local fauna "endemics".

Acknowledgments

We thank Richard H. Tedford and Malcolm C. McKenna (AMNH), Robert W. Wilson and Lawrence H. Martin (UK), Barry S. Kues (UNM) and Robert J. Emry and Robert Purdy (USNM) for permission to examine specimens in their care. Schoch thanks J. David Archibald, Debera Edwards, Barbara Honey, Geraldine P. Kochan, Patricia Lewis, Linda J. Reichlin and Leslie F. Ruppert for logistic support in visiting some of the above institutions and David E. Schindel for the use of photographic equipment. Schoch gratefully acknowledges financial support from the National Science Foundation in the form of a Graduate Fellowship. Lucas thanks Jeffrey Froehlich, Barry Kues, Michael O'Neill, Peter Reser and Costas Tsentas for invaluable assistance in the field. We thank John H. Ostrom and Bruce H. Tiffney for helpful criticism of the manuscript.

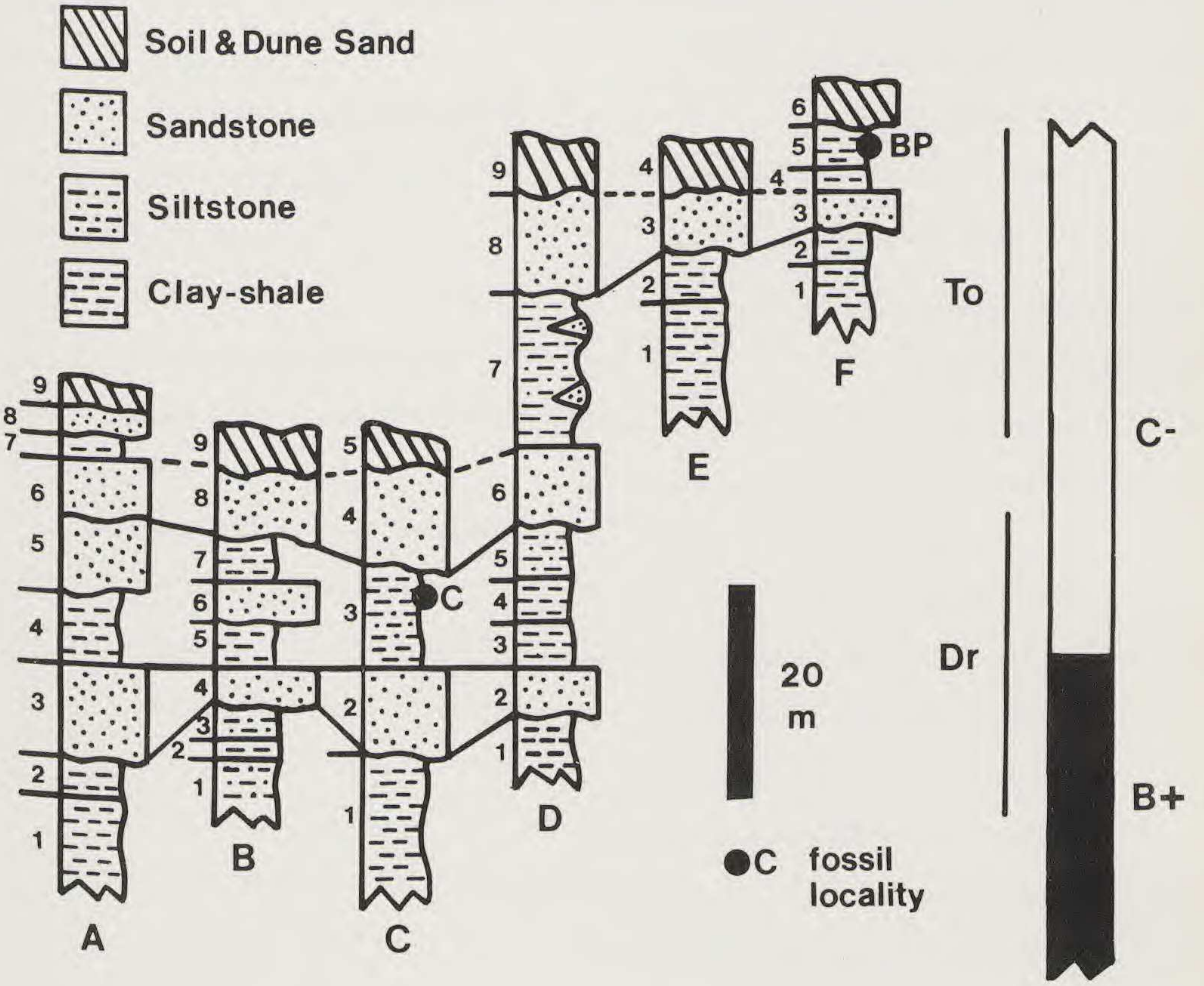


Fig. 8
Measured sections of the upper part of the Nacimiento Formation in the west fork of Kutz Canyon, San Juan Basin, New Mexico, and their correspondence to Taylor and Butler's (1980, fig. 9) magnetic-polarity stratigraphy of the Big Pocket area in Kutz Canyon. The type locality of *C. pattersoni*, UNM vertebrate locality 1096 (C), is just above normal polarity magnetozone *B+* in the lower part of reversed polarity magnetozone *C–*. It falls within the "Dragonian" interval (*Dr*) defined by Tomida and Butler (1980, fig. 9). The Big Pocket locality where referred specimens of *C. pattersoni* were collected is in the upper part of magnetozone *C–*, well within the Torrejonian interval (*To*) defined by Tomida and Butler (1980, fig. 9). For the location of these sections see Fig. 1; sections are described in the Appendix.

Appendix Descriptions of Measured Sections in Figure 8

Section A

Unit	Lithology	Thickness (meters)
9	Stabilized soil and dune sand of (?) Quaternary age	Not measured
Unconformity (erosional)		
Nacimiento Formation		
8	Sandstone: gray and buff-colored, medium- to coarse-grained, arkosic; forms ridges	2.0
7	Clay-shale: yellow	1.5
6	Sandstone: brown, medium- to coarse-grained, arkosic; forms cliffs	4.5
5	Sandstone: gray and buff-colored, medium- to coarse-grained; weathers into ledges	7.0
4	Clay-shale: green and black	7.0
3	Sandstone: brown, medium- to coarse-grained, arkosic	9.0
2	Clay-shale: black	3.0
1	Clay-shale: green and gray, base covered by alluvium in arroyo floor	8.5+

Section B

Unit	Lithology	Thickness (meters)
9	Same as unit 9, section A	Not measured
Unconformity (erosional)		
Nacimiento Formation:		
8	Same as unit 6, section A	6.0
7	Clay-shale: green and black	4.0
6	Sandstone: gray, medium-grained, quartzose	4.0
5	Clay-shale: red and green, numerous calcitic concretions	4.0
4	Same as unit 3, section A	4.0
3	Siltstone: gray and green	3.0
2	Clay-shale: purple and red	1.0
1	Siltstone: green, yellow and gray; base covered by alluvium in arroyo floor	6.0+

Section C

Unit	Lithology	Thickness (meters)
5	Same as unit 9, section A	Not measured
Unconformity (erosional)		
Nacimiento Formation:		
4	Same as unit 6, section A	9.0
3	Clay-shale: green, purple and gray. UNM vertebrate locality B-1096, the type locality of C. pattersoni, is 2 m below the top of this unit.	9.0
2	Same as unit 3, section A	8.5
1	Clay-shale: green, gray and brown; base covered by alluvium in arroyo floor	14.0+

Section D

Unit	Lithology	Thickness (meters)
9	Stabilized soil and dune sand of (?) Quaternary age	Not measured
Unconformity (erosional)		
Nacimiento Formation		
8	Sandstone: brown and yellow, coarse-grained, arkosic; forms ridges and cliffs.	9.0
7	Clay-shale and siltstone: green and red with some lenses of gray-white quartzose sandstone	14.0
6	Same as unit 6, section A	7.0
5	Siltstone: gray and green	5.0
4	Clay-shale: Black	4.0
3	Clay-shale: green and gray	4.0
2	Same as unit 3, section A	4.0
1	Clay-shale: green and yellow; base covered by alluvium in arroyo floor	6.0+

Section E

Unit	Lithology	Thickness (meters)
4	Same as unit 9, section D	Not measured
Unconformity (erosional)		
Nacimiento Formation		
3	Same as unit 8, section D	5.0
2	Clay-shale: yellow, green and gray	4.0
1	Clay-shale: green, buff and gray; total thickness not measured	12.0+

Section F

Unit	Lithology	Thickness (meters)
6	Same as unit 9, section D	Not measured
Unconformity (erosional)		
Nacimiento Formation		
5	Clay-shale: red and green. The Big Pocket locality is in the middle of this unit.	4.0
4	Clay-shale: prominent green band	2.0
3	Same as unit 8, section D	3.5
2	Clay-shale: purple, laterally gives way to black and yellow clay-shale	3.0
1	Clay-shale: green, gray and brown; total thickness not measured	6.0+

Literature Cited

Cope, E.D. 1876. On the Taeniodonta, a new group of Eocene Mammalia. Proc. Acad. Nat. Sci. Philadelphia 28:39.

——— 1888. Synopsis of the vertebrate fauna of the Puerco series. Trans. Am. Philos. Soc., N.S. 16:298–361.

Evernden, J.F., D.E. Savage, G.H. Curtis and **G.T. James.** 1964. Potassium-argon dates and the Cenozoic mammalian chronology of North America. Am. J. Sci. 262:145–198.

Gazin, C.L. 1938. A Paleocene mammalian fauna from central Utah. J. Wash. Acad. Sci. 28:271–277.

——— 1939. A further contribution to the Dragon Paleocene fauna of central Utah. J. Wash. Acad. Sci. 29:273–286.

——— 1941. The mammalian faunas of the Paleocene of central Utah, with notes on the geology. Proc. U.S. Natl. Mus. 91:1–53.

Marsh, O.C. 1875. New order of Eocene mammals. Am. J. Sci. 9:221.

Matthew, W.D. 1937. Paleocene faunas of the San Juan Basin, New Mexico. Trans. Am. Philos. Soc. 30:1–510.

Patterson, B. 1949. Rates of evolution in taeniodonts, pp. 243–278. *In* G.L. Jepsen, G.G. Simpson and E. Mayr [eds.] Genetics, Paleontology and Evolution. Princeton Univ. Press, Princeton.

Russell, D.E. 1967. Le Paléocène continental d'Amérique du Nord. Mém Mus. Natl. Hist. Nat., Paris, Sér. C, 16:37–99.

Schlosser, M. 1911. Mammalia. Vol. 2, p. 325–585. *In* F. Broili, E. Koken and M. Schlosser [eds.] Grundzüge der Paläontologie (Paläozoologie) von Karl A. von Zittel. Druck und Verlag von R. Oldenbourg. München und Berlin.

Schoch, R.M. and **S.G. Lucas**. 1981. The biostratigraphic and geographic distribution of the mammalian order Taeniodonta. Geol. Soc. Am. Abstr. with Progr. 13:225.

Sloan, R.E. 1970. Cretaceous and Paleocene terrestrial communities of western North America. Proc. N. Am. Paleontol Conv. 1:427–453.

Szalay, F.S. 1969. Mixodectidae, Microsyopidae, and the insectivore-primate transition. Am. Mus. Nat. Hist. Bull. 140:193–330.

Taylor, L.H. 1981. The Kutz Canyon local fauna, Torrejonian (middle Paleocene) of the San Juan Basin, New Mexico, p. 242-263. *In* S.G. Lucas, J.K. Rigby, Jr. and B.S. Kues [eds.] Advances in San Juan Basin Paleontology. Univ. New Mexico Press, Albuquerque.

Taylor, L.H. and **R.F. Butler.** 1980. Magnetic-polarity stratigraphy of Torrejonian sediments, Nacimiento Formation, San Juan Basin, New Mexico. Am. J. Sci. 280:97–115.

Tomida, Y. 1981. "Dragonian" fossils from the San Juan Basin and status of the "Dragonian" land mammal "Age", p. 222–241. *In* S.G. Lucas, J.K. Rigby, Jr. and B.S. Kues [eds.] Advances in San Juan Basin Paleontology. Univ. New Mexico Press, Albuquerque.

Tomida, Y. and **R.F. Butler.** 1980. Dragonian mammals and Paleocene magnetic polarity stratigraphy North Horn Formation, central Utah. Am. J. Sci. 280:787–811.

Tsentas, C. 1981. Mammalian biostratigraphy of the middle Paleocene (Torrejonian) strata of the San Juan Basin: Notes on Torreon Wash and the status of the *Pantolambda* and *Deltatherium* faunal "Zones", p. 264–292. *In* S.G. Lucas, J.K. Rigby, Jr. and B.S. Kues [eds.] Advances in San Juan Basin Paleontology. Univ. New Mexico Press, Albuquerque.

Wilson, R.W. 1956. A new multituberculate from the Paleocene Torrejon fauna of New Mexico. Trans. Kansas Acad. Sci. 59:76–84.

Wilson, R.W. and **F.S. Szalay.** 1972. New paromomyid primate from middle Paleocene beds, Kutz Canyon area, San Juan Basin, New Mexico. Am. Mus. Novitates No. 2499, 18 p.

Wood, H.E., R.W. Chaney, J. Clark, E.H. Colbert, G.L. Jepsen, J.B. Reeside, Jr. and **C. Stock.** 1941. Nomenclature and correlation of the North American continental Tertiary. Bull. Geol. Soc. Am. 52:1–48.

The Authors

Robert M. Schoch and **Spencer G. Lucas.**
Department of Geology and Geophysics and Peabody Museum of Natural History, Yale University, 170 Whitney Avenue, PO Box 6666, New Haven, CT 06511.